



Science Unit: *Matter*

Lesson 4: *Changing States of Matter - Making Ice Cream*

School year: 2005/2006

Developed for: McBride Elementary School, Vancouver School District

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Grade level: Presented to grades 2 - 3; appropriate for grades 1 - 4 with age appropriate modifications.

Duration of Lesson: 1 hour and 25 minutes (with demonstrations)

Objectives

1. Review properties of liquids and solids.
2. Learn about changing states of matter by heating and cooling.
3. Learn about permanent and reversible physical changes to matter.
4. Gain experience by making predictions, doing a science experiment, and making observations.

Background Information

Matter is anything that occupies space. The three states of matter are solids, liquids and gases. Physical changes can happen to matter, but no new material is produced and the molecules do not change. Some physical changes to matter are permanent whereas other changes are reversible. Heat and cold can change the state of matter depending on temperature and the composition of the matter. When matter is sufficiently cooled it usually goes from a gas to a liquid to a solid.

Making ice cream is a change of state from a liquid (liquid mixture of cream and sugar) to a solid (ice cream) due to cooling from the ice and salt. Salt actually lowers the freezing point of water. Salt is used on icy roads in the winter to actually melt the ice. Water normally freezes at 0 degrees Celsius. With a 10% salt solution water will freeze at -6 degrees Celsius. In old-fashioned ice cream makers, a mixture of rock salt, crushed ice and water can have a temperature as low as -21 degrees Celsius. By lowering the temperature at which ice is frozen one is able to cool the liquid cream mixture sufficiently to make ice cream.

Vocabulary

Matter: Something (a substance) that occupies space; what something is made of; the three states of matter are solids, liquids and gases; matter is made up of molecules.

Solid: A substance that has its own shape (keeps its form); a solid usually feels firm; the shape of solids can change but the solid material takes up the same amount of space.

Liquid: A substance that flows easily and takes the form of its container; liquids take up the same amount of space regardless of the size and shape of the container.

Gas: A substance that does not have its own shape; it can expand indefinitely or be contained in a container.

Molecule: The smallest particle of a substance that retains all of the properties of the substance; comprised of two or more atoms and sub-atomic particles.



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Atom: The smallest particle of an element that can exist either alone or in combination.
Sublimation Passage of a substance directly from a solid state to a gas state

Materials (needed for each student)

- Vanilla (a drop or two)
- whipping cream (50 ml or less) A 1litre carton should be sufficient for a class of 20-22 students
- sugar (1 tsp)
- salt (6-8 Tbsp)
- crushed ice (buy 2 bags of cubed ice and then pre-crush it with a rolling pin or hammer until finely crushed)
- Dixie cup 150 ml (the ones that come from bathroom dispensers)
- Styrofoam deli container (500 ml)
- plastic spoon or stir stick
- metal spoon to mix salt and ice
- ice chest to keep ice cold

Materials Needed for Demonstrations (Making Rain, Dry Ice Sublimation, Condensation)

- electric kettle filled with water
- ladle or large serving spoon previously cooled in the freezer for 1 hour
- dry ice (frozen carbon dioxide - available at Praxair 1470 Derwent Way, Delta Tel. 604 527-0710)
- thin rubber glove or balloon
- elastic band
- pin
- ice cubes
- glass

In the Classroom

Introductory Discussion

1. Review properties of solids, liquids and gases.
2. Safety rules: Ask questions if you don't understand how to do something in an experiment. Don't put anything in your mouth or near your eyes during the science experiment. Wash your hands after the science activity.
3. Demonstrations: **Making Rain:** Using a kettle with boiling water and a very cold ladle or large spoon that has been in the freezer for 1 hour, hold the cold spoon over the steam and students will see condensation droplets forming and dropping from the bottom of the spoon. Discuss water changing into steam (water vapour), then back to water again (condensation). What happens to puddles after the sun comes out? Or after a very cold night?
4. Ask what happens to the bathroom mirror after you take a long hot shower, or bath? Or the outside of a cold glass of lemonade on a hot day. **Condensation:** Try putting ice cubes and water in a glass and placing it in a warm place. Observe what happens at the end of the class. You should



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see water droplets on the outside of the glass. Ask students how the droplets got there? Warm air in the classroom is filled with water vapour. As the air hits the cold surface of the glass, the vapour condenses into water droplets.

5. **Dry Ice Sublimation:** Fill the classroom sink with water and carefully place a piece of dry ice in the water. **Warning: Dry ice is extremely cold and can cause frostbite to exposed skin. Do not let students touch it. Also dry ice is frozen carbon dioxide and needs to be handled in well-ventilated areas. Do not breathe in the carbon dioxide fumes.** Ask what is happening? Frozen carbon dioxide (a solid) changes directly to a gas (carbon dioxide that we breathe out). This is called sublimation. Unlike ice which changes first to a liquid phase (water) and then upon heating changes to a gas (water vapour), frozen carbon dioxide has bypasses the liquid phase. Carbon dioxide is heavier than air and so the students will observe the gas “spilling over” the side of the sink and sinking to the floor.
6. A chunk of dry ice can be carefully placed in a rubber glove or balloon. Seal it with an elastic band and watch it blow up by itself as the dry ice changes in to a gas. Poke the glove/balloon before it bursts.
7. If it is a cold day, students can try and exhale on to an area of a cold window and see it “fog up”. This is the warm water vapour (gas) from their breath, hitting a cold surface and condensing into tiny water droplets (liquid).
8. Before serving the ice cream to students, ensure that no student is allergic to vanilla or is lactose intolerant.

Science Activity/Experiment

1. The whipping cream, sugar and vanilla can be pre-mixed directly in the whipping cream carton to save time.
2. Each student can line up and collect the Styrofoam dish. Fill dish with crushed ice, and then add 6-8 Tbsp of salt and mix well with a metal spoon.
3. Make a hole in the ice and salt mixture in your Styrofoam dish and nestle in the Dixie cup with about 50 ml (or less) of whipping cream mixture. The top of the Dixie cup should be 2-3 cm above the top of the Styrofoam dish to avoid contamination. **DO NOT LET THE SALT AND ICE MIX WITH YOUR WHIPPING CREAM MIXTURE!**
4. Stir whipping cream mixture with a clean plastic spoon or stir stick, slowly and carefully. Pause periodically to let the cream mixture freeze faster. It will take about 20 minutes for the ice cream to form. Be patient!
5. Take out the Dixie cup once the ice cream has formed and enjoy it!

Closure Discussion

1. Discuss predictions, observations and results for the “Making Ice Cream” activity.
2. Were your predictions the same as your observations? Promote discussion of changing states of matter with questions such as:
 - Why did we use salt to make ice cream? What changes of state did you see?
 - What other liquid matter freezes into a solid when cooled?
 - What other matter turns into a liquid when heated?
 - What surprised you?



References

1. Ontario Science Centre. 1995. Solids, Liquids and Gases. Starting with Science Series. Pp. 12-13, pp. 24-25. Kids Can Press Ltd. Toronto.
2. Drago, C. (Ed.) 2000. The Big Book of Experiments: An Encyclopedia of Science. Pp. 160-163. Brown Watson, English Edition.
3. Patten, J.M. 1995. Solids, Liquids and Gases. Let's Wonder About Science Series. Rourke Book Co. Vero Beach, Florida.
4. Patten, J.M. 1995. Liquid to Gas and Back. Let's Wonder About Science Series. Rourke Book Co. Vero Beach, Florida.
5. Mellett, Peter. 2001. Hands-On Science: Matter and Materials. Kingfisher Publications. Boston.
6. <http://www.school-for-champions.com/science/matterstates.htm> States of Matter by Ron Kurtus. Revised Nov. 6, 2003.
7. <http://www.teachnet.com/lesson/science/icecream051999.html> Making ice cream in Ziploc Bags.
8. <http://www.teachers.net/lessons/posts/454.html> Making ice cream.

Making Ice Cream

Name: _____

I need: _____

I observed:

<p style="text-align: center;">Before</p>	<p style="text-align: center;">After</p>
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I learned:
